



EFFECT OF GREEN TEA ON ENAMEL REMINERALIZATION OF TEETH IMMersed IN PEPSI

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ABSTRACT

Introduction: A rise in acidic products consumption has led to an increase in the percentage of eroded enamel and dentin. A new remineralization method is the consumption of green tea, which suspected to have remineralization properties.

Aim of the work: This study determined the impact of green tea on enamel remineralization of immersed teeth in pepsi.

Materials and Methods: After clinical and radiographic examinations, 30 sound permanent posterior teeth that were newly extracted for orthodontic purposes were chosen. Each tooth was sectioned into 4 quadrants at right angle to the root long axis. We choose cervical region for the present research. Sectioned teeth were grouped into 3 sets; 40 specimens for each. Group I: served in artificial saliva. Group II: specimens immersed in Pepsi beverages. Group III: specimens were demineralized by Pepsi drink for 3 hours and then immersed in green tea. All samples have been evaluated after 4 weeks using scanning electron microscopy

Results: The application of green tea has considerably reduced the roughness of the enamel surface, improving the capacity for enamel remineralization.

Conclusions: Green tea is effective in preventing the erosion of enamel and a promising remineralization material

INTRODUCTION

The structure of the tooth is continuously demineralized and remineralized orally and when this equilibrium interrupted, demineralization will deteriorate the structure of the tooth¹. Consumption of soft drinks such as PEPSI has been reported to lead to dental erosion². Eliminating the cause of

dental erosion in people is not always practical, so it is necessary to create other efficient preventive approaches for managing dental erosion³.

Demineralization is started by softening of the enamel surface, consequently dissolving of enamel crystals incrementally, resulting in disintegration of tooth structure.⁴⁻⁶.

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Green tea has a distinctive structure. It contains fructose, sucrose, glucose, cellulose, pectin, and lipid components such as linoleic and linolenic acids and sterols as stigmasterol. Green tea contains around 5-7% minerals, mainly potassium, phosphorus, calcium, and magnesium, as well as small quantities zinc, manganese, copper also, it contains vitamins, chlorophyll pigments and carotenoids,⁷

Green tea can be used as antioxidant, antimutagenic and anticarcinogenic. It is used to improve oral health including periodontal disease, loss of tooth, dental caries, abolition of halitosis, oral malignancy prevention and regression,⁸.

The aim of the present study to determine the impact of green tea on enamel remineralization of immersed teeth in Pepsi.

MATERIALS AND METHODS

After clinical and radiographic examinations, 30 sound permanent newly extracted posterior teeth chosen. They were collected from healthy people on the basis of a protocol approved by the Mansoura University Ethical Committee. To avoid any fungal or bacterial growth, the teeth were stored in 0.5% sodium azide solution at 4°C and used within 1 month after extraction.

Each tooth sectioned in bucco-lingual and mesio-distal direction into 4 sections by a high speed diamond tipped disc. From each tooth, 4 specimens were prepared. (30 teeth i.e. 4×30= 120 specimens, total).

Polishing of enamel surface was prevented to avoid removal of the outer prismless enamel.

The sectioned teeth were divided into 3 groups (N=120); 40 specimens each, examined after 4 weeks. **Group I:** served as control group, at room temperature the specimens were stored in artificial saliva. **Group II:** Specimens were twice daily subjected to pH cycling by immersing in 10 ml of a newly opened Pepsi drink, in a distinct container at room temperature for 5 minutes and then in

artificial saliva, Pepsi drinks is used in this study as demineralizing agent because it contains phosphoric acid and citric acid which soften the enamel of the teeth,⁹ **Group III:** Specimens were demineralized by Pepsi drink for 3 hours and immersed in 20 ml of green tea for the remaining 21 hours.. This was repeated daily for 4 weeks, after which surface micro hardness was measured under scanning electron microscope.

Green tea preparation:

Ten grams of sealed and dry raw Chinese green tea leaves (Fuan Ming Hung Tea Co) were poured into 100 mL of boiled water. The green tea leaves were steep in the water for 5 minutes after that it was filtered with strainer and cooled off for 10 minutes at room temperature,¹⁰.

RESULTS

Examination of enamel surfaces with scanning electron microscopy revealed:

Group I: showed normal homogenous smooth architecture of enamel with certain cracks, which may be due to excessive brushing of the tooth at home. **Fig. (1A, B)** **Group II:** After 4 weeks with the longer exposure period, the erosion of surface of enamel was apparent, as there was significant increase in the roughness of the enamel surface. **Fig. (1C, D).** **Group III:** the scanning electron microscopy showed smooth surface of enamel without any irregularities or porosities. After 4 weeks, it was interesting to identify the least roughness of the enamel surface. **Fig. (1E, F)**

Enamel surface roughness:

Statistical results showed difference in the measured enamel surface roughness between the different groups. Enamel surface roughness showed high significance difference ($P < 0.001$) when compared group III with group I and II while showed significant difference ($P < 0.05$) when compared group I with group II. (Table 1)

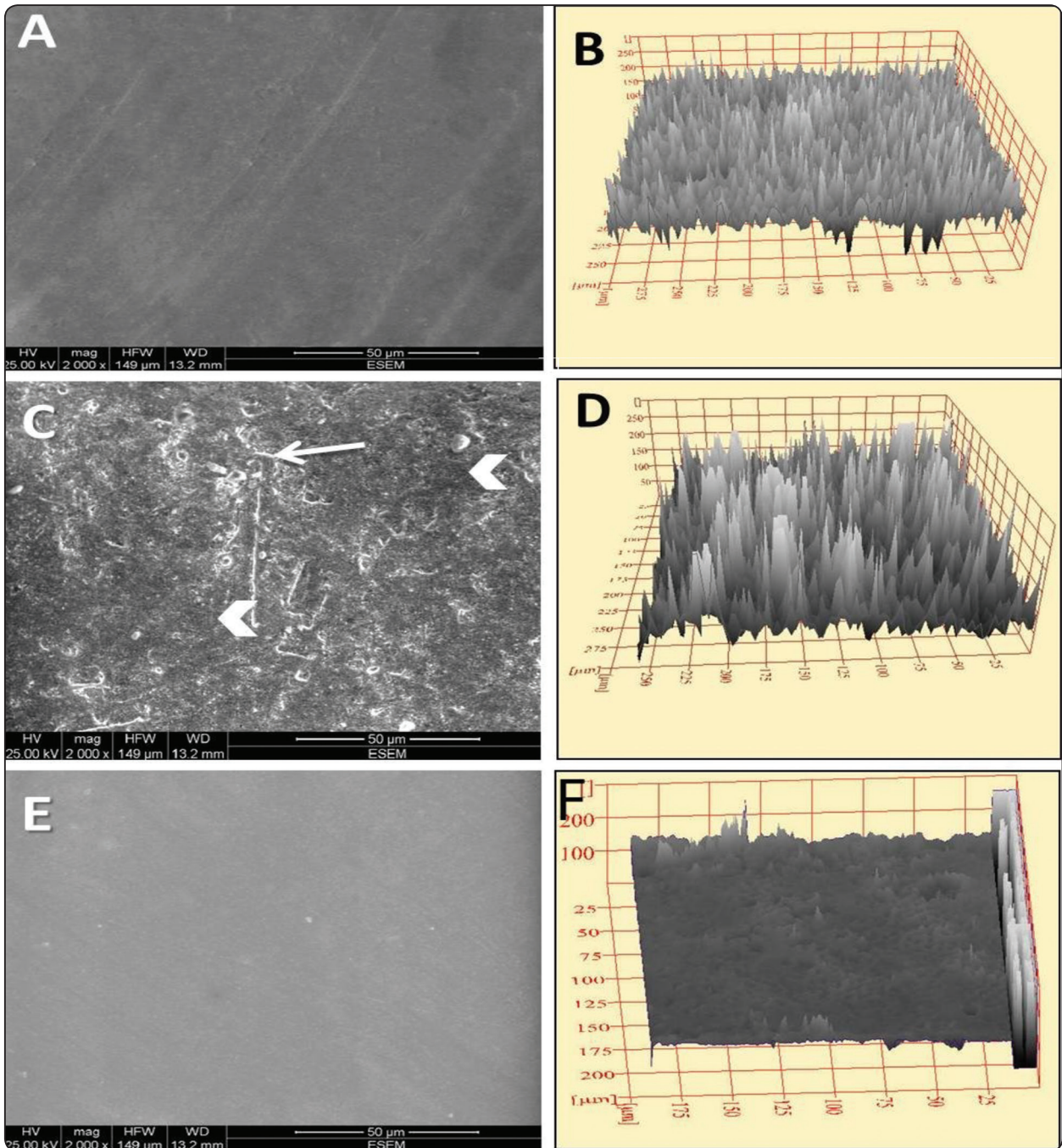


Fig. (1): photomicrograph of ESEM of enamel surface after 4 weeks ($\times 2000$). **A (Group I):** shows normal enamel surfaces. There were remnants of a prismatic layer. **C (Group II):** porosity areas that are evident on surface of enamel (*white arrow*) and areas of depression (*head arrows*). **E (Group III):** shows a smooth surface of enamel. (No evidence of irregularities or porosities). **B (Group I), D (Group II) and F (Group III):** After 4 weeks, ESEM histogram shows roughness of enamel surface. Minimum enamel surface roughness is shown in **F**.

Statistical analysis of ESEM results

TABLE (1) Showing statistical analysis of the enamel surface roughness using one-way ANOVA test.

Enamel surface roughness							
	Group 1		Group2		Group3		ANOVA P value
	Mean	SD	Mean	SD	Mean	SD	
	140.87	1.21	240.00	46.16	105.57	0.49	<0.001
P1			0.01		0.00		
P2					0.00		

DISCUSSION

Despite the enamel remineralizing capacity of saliva, the process of increasing calcium and phosphate levels cannot be initiated by itself.¹¹ Remineralization was a major investigative area. Padmini et al., 2013 mentioned that preventing the beginning and disruption of enamel erosion can manage disintegration¹².

The current research was conducted to determine the effect of green tea on the eroded enamel surface. One of the most commonly consumed acidic beverages is Pepsi so it was used in our study. Parry et al., 2001¹³ reported that gas removal from PEPSI drinks might elevate their pH and reduce their potential for hydroxyapatite dissolution. PEPSI containers have therefore been hermetically sealed. Singh et al., 2010, stated that as storage medium, artificial saliva was chosen to simulate the oral environment¹⁴.

In group II with prolonged exposure time to Pepsi, enamel demineralization occurs. Moreover, this was supported by Chandna et al., 2011¹⁵ who reported that enamel demineralization occurs when pH of enamel surface drops below pH 5.5. Also, Sauro et al., 2008¹⁶ stated that acidic beverages acts as chelators; binding minerals like Ca.

The statistical analysis comparisons between group III and group II showed a substantial reduction

in the roughness of the enamel surface in group III. These findings show green tea's protective impact against enamel erosions.

Green Tea extract showed a significant reduction in streptococcus mutans and lactobacillus concentration compared with subjects using placebo. This is likely owing to the antibacterial characteristics of polyphenols connected with inhibiting bacterial cells ' attachment to tooth surfaces,,^{17,18}.

Jaâfoura S, et al., 2014 stated that the anti-erosion effect of sugar-free green tea could be explained by its high pH value, the pH of green tea is about 6.3, while fruity tea with high citric acid content have low pH around 2,98 to 3.95 and pH of ice tea is about 3.00. They also found that modification of green tea by adding calcium, phosphate, fluoride ions could enhance the anti-erosion effect,¹⁹.

The improvement of enamel surface in group III is strong evidence that green tea reduces the wear of enamel and enhances their surface quality, which agrees with Kato et al.,²⁰ result. They also found that the dentin wear was reduced significantly when ten volunteers rinsed with green tea for one minutes between each erosive (five min, cola drink) and abrasive challenge (30s, tooth brushing).

The observed results in group III can be explained by the presence of Matrix metalloproteinases

(MMPs) in enamel and dentin which is responsible for the breakdown of extracellular matrix in normal physiological processes. MMPs may participate in the organization of enamel and dentin organic matrix before mineralizing the teeth and control the proteoglycan turnover and remodeling of enamel and dentin and thus regulate mineralization. MMPs especially MMPs 20, also known as enamel metalloproteinase, degrades amelogenin, which is the major protein component of the enamel matrix that organizes the enamel rods during tooth development and controls the initiation and growth of hydroxyapatite crystals during the enamel mineralization,²¹.

Shahad H Rajab, et al., 2018,¹⁰ proved that when the pH falls down with the presence of intrinsic or extrinsic acids as coca cola the MMPs are activated. When they get activated they start to hydrolyze the extracellular matrix components (ECM) of enamel. In this context, the existence of MMPs on eroded enamel would probably increase the development of erosion that could be avoided by the use of inhibitors of MMP,²².

One of MMPs inhibitors that were used in this study in order to prevent enamel erosion was green tea. Green tea has the ability of protecting the eroded enamel by increasing the surface micro hardness and decreasing the surface roughness of eroded enamel.²³

Although the current research was unable to simulate the complicated oral environment, it demonstrated the ability for green tea to overcome the damaging impact of PEPSI beverages on enamel surfaces

CONCLUSION

Based on the results of this study, it may be concluded that the use of green tea was efficient in stopping the erosion of enamel generated by Pepsi beverages and increased the potential for remineralization.

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